ABSTRACT

An ion trap comprises a three-dimensional, rotationally symmetric ring electrode and two cap electrodes with hyperbolic surfaces facing toward the inside of the ion trap, each of the two cap electrodes being further composed of a first hyperbolic cone electrode and a second disk electrode. The ion trap also includes a RF or periodic circuitry constructed and arranged for applying a RF or periodic voltage to the ring electrode to generate a main quadrupole field, an AC circuitry constructed and arranged for applying an AC voltage to the disk electrodes of said two cap electrodes to generate a dipole field, and a DC circuitry constructed and arranged for applying an DC voltage to the cone electrodes of the two cap electrodes to independently generate an electrically variable electrostatic octopole field in the ion trap. The ion trap is capable to achieve higher mass-resolving power, especially in higher gas pressure or lower vacuum condition. To achieve higher mass-measuring sensitivity, the ion trap can be switched electrically between the three-dimensional trap mode and two-dimensional trap mode by dividing the trap's ring electrode into multiple elements.